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U.S.C. 154(b) by 0 days.

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(56) References Cited

U.S. PATENT DOCUMENTS

7,415,173 B2*	8/2008	Kassamakov	G06F 1/1616
			250/231.18
8,581,859 B2*	11/2013	Okumura	G06F 1/1626
			345/173

8,958,201	B2*	2/2015	Leung G06F 1/1626	
			361/679.27	
8,976,141	B2*	3/2015	Myers H04M 1/0268	
			345/173	
9.176,535	B2 *	11/2015	Bohn G06F 1/1641	
9,348,362	B2 *	5/2016	Ko G06F 1/1626	
9,348,450	B1*	5/2016	Kim G06F 1/1681	
9,504,170	B2 *	11/2016	Rothkopf H04M 1/0216	
9,541,962	B2 *	1/2017	Siddiqui G06F 1/1618	
9,594,401	B2 *	3/2017	Liang G06F 1/1618	
9,664,210	B2	5/2017	Ou et al.	
9,891,670	B2 *	2/2018	Kim G06F 1/1652	
9,927,841	B2 *	3/2018	Gheorghiu G06F 1/1652	
9,930,152	B2 *	3/2018	Kim G06F 1/1652	
9,952,627	B2 *	4/2018	Aurongzeb G06F 1/1641	
10,013,022	B1*	7/2018	Aurongzeb G06F 1/1616	
(Continued)				

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(57) ABSTRACT

A personal computing device comprises a single piece body having a seamless overall appearance and that includes a bendable portion that is capable of having a smoothly curved shape. The single piece body includes a first part capable of carrying a display suitable for presenting visual content, and a second part that is capable of carrying an input device suitable for accepting an input action. The personal computing device also includes a multi-state bending assembly carried by the single piece body at the bendable portion and positioned between and in mechanical communication with the first part and the second part. The multi-state bending assembly includes a planar assembly that, in a first state, is characterized as having a first thickness and allows relative movement of the first and second parts with respect to each other. In a second state, the planar assembly is characterized as having a second thickness, less than the first thickness, that is capable of maintaining a fixed angular displacement between the first and second parts.

20 Claims, 9 Drawing Sheets

